Ship to Stock Process for DRAMS

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ABSTRACT: This document describes a process for selecting and identifying dynamic random access memory (DRAM) chips. It also describes how to monitor the performance of parts on the ship to stock (STS) program.

APPLICABILITY: This procedure is a guide for all stock points and warehouses.

STATUS: APPROVED 14-Sep-1990; use VTX SMC for current status.

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APPROVAL: This document has been reviewed and recommended for approval by the General Review group for its category.

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Use VTX SMC to order copies of this document from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

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1 INTRODUCTION

This document describes a process for implementing a Ship to Stock (STS) process for DRAMs. It is to be used by Digital personnel as a guide in selecting, evaluating, and placing DRAMs on STS, as well as monitoring their performance after being placed on STS.

This document lists the participating groups/personnel, and their associated responsibilities in implementing the process.

2 DRAM STS PROGRAM OFFICE ORGANIZATION

Figure 1 shows the DRAM STS program office organization and Figure 2 shows the process flow for DRAMs.

Figure 1: DRAM STS PROGRAM OFFICE ORGANIZATION

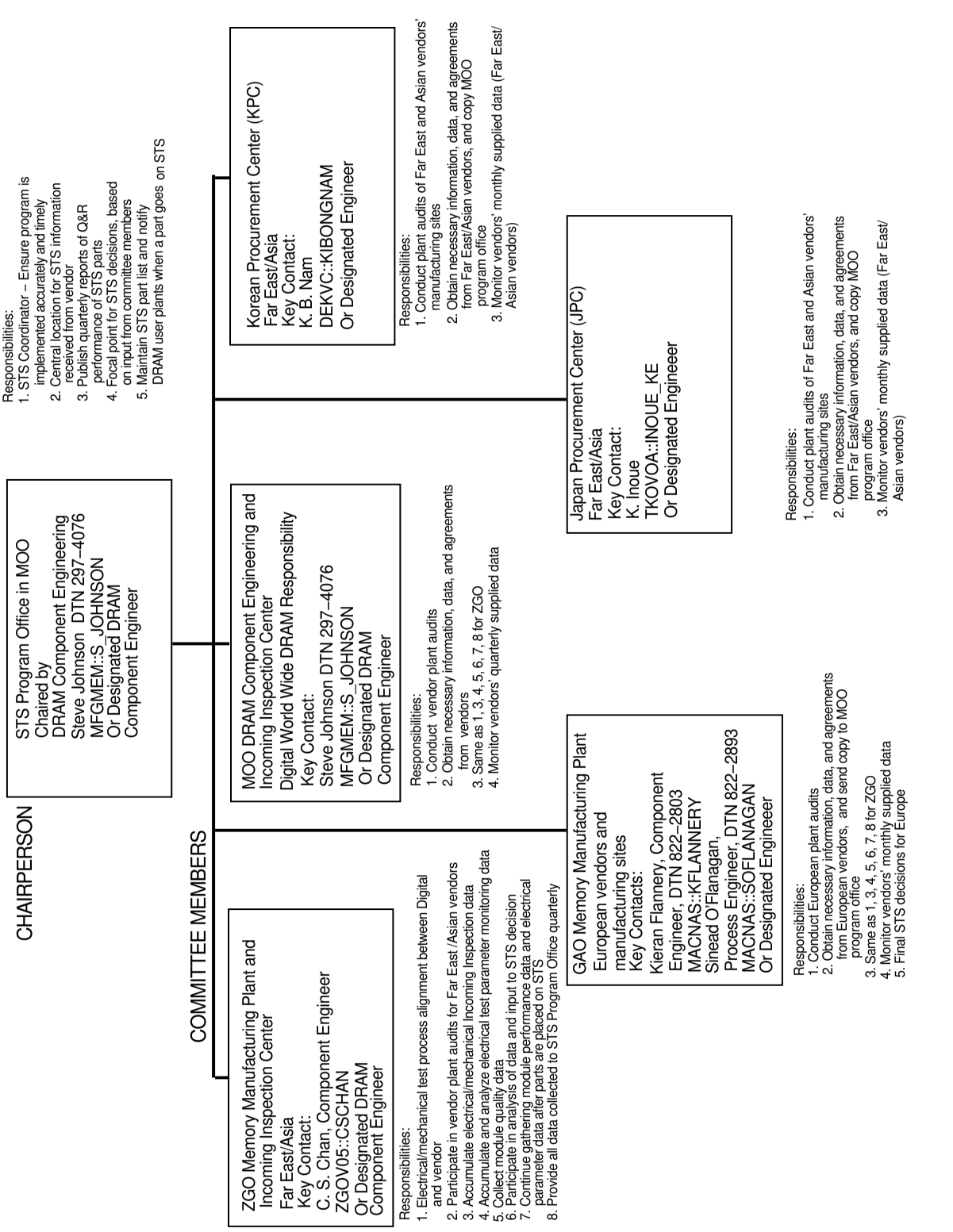
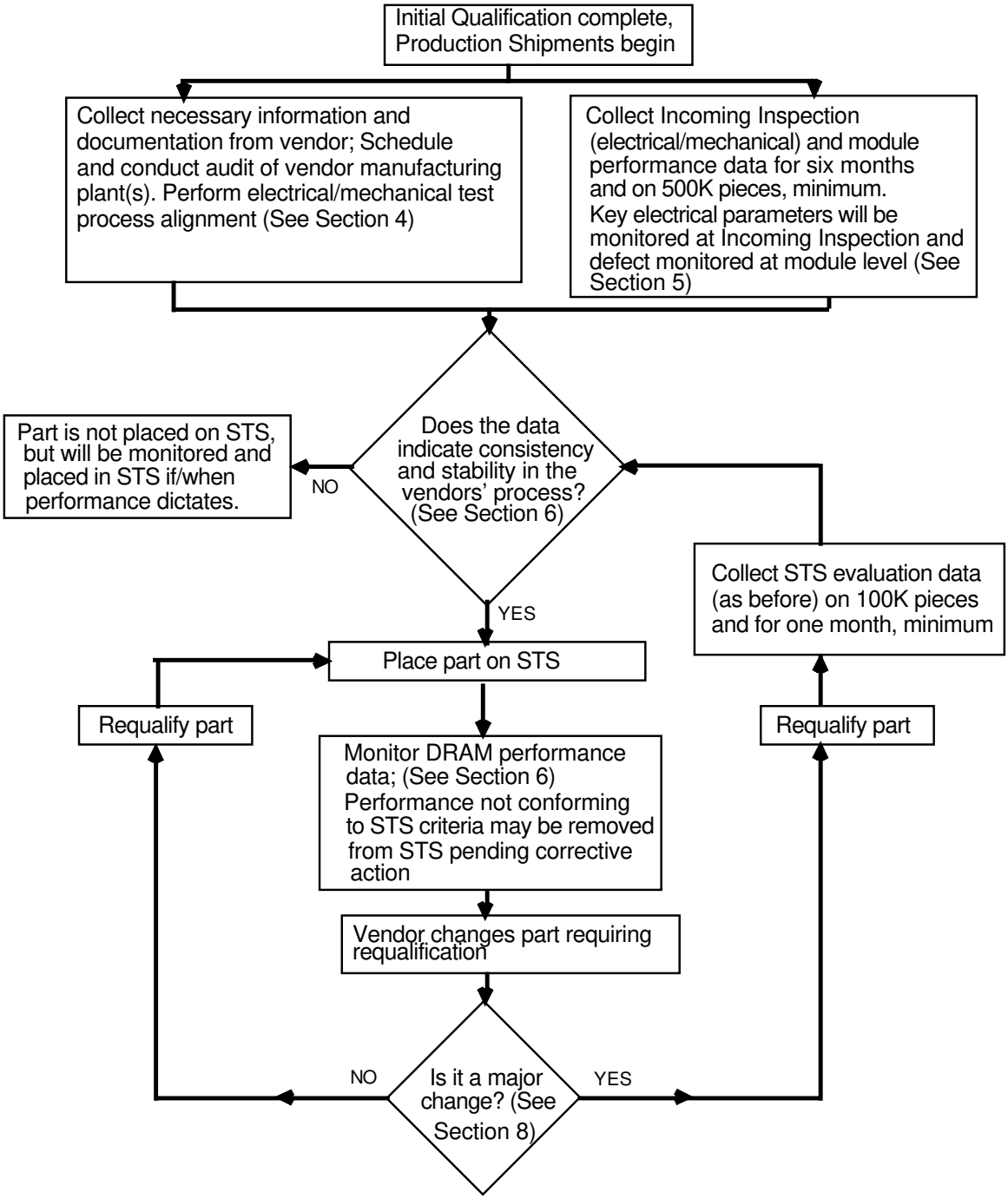

CHAIRPERSON
STS Program Office in MOO
Chaired by
DRAM Component Engineering
Steve Johnson DTN 297–4076
MFGMEM::S_JOHNSON
Or Designated DRAM
Component Engineer
Responsibilities:
1. STS Coordinator – Ensure program is implemented accurately and timely
2. Central location for STS information received from vendor
3. Publish quarterly reports of Q&R performance of STS parts
4. Focal point for STS decisions, based on input from committee members
5. Maintain STS part list and notify DRAM user plants when a part goes on STS
COMMITTEE MEMBERS
ZGO Memory Manufacturing Plant and Incoming Inspection Center
Far East/Asia
Key Contact:
C. S. Chan, Component Engineer
ZGOV05::CSCHAN
Or Designated DRAM
Component Engineer
Responsibilities:
1. Electrical/mechanical test process alignment between Digital and vendor
2. Participate in vendor plant audits for Far East /Asian vendors
3. Accumulate electrical/mechanical Incoming Inspection data
4. Accumulate and analyze electrical test parameter monitoring data
5. Collect module quality data
6. Participate in analysis of data and input to STS decision
7. Continue gathering module performance data and electrical parameter data after parts are placed on STS
8. Provide all data collected to STS Program Office quarterly
MOO DRAM Component Engineering and Incoming Inspection Center
Digital World Wide DRAM Responsibility
Key Contact:
Steve Johnson DTN 297–4076
MFGMEM::S_JOHNSON
Or Designated DRAM
Component Engineer
Responsibilities:
1. Conduct vendor plant audits
2. Obtain necessary information, data, and agreements from vendors
3. Same as 1, 3, 4, 5, 6, 7, 8 for ZGO
4. Monitor vendors' quarterly supplied data
GAO Memory Manufacturing Plant
European vendors and manufacturing sites
Key Contacts:
Kieran Flannery, Component Engineer, DTN 822–2803
MACNAS::KFLANNERY
Sinead O'Flanagan, Process Engineer, DTN 822–2893
MACNAS::SOFLANAGAN
Or Designated Engineer
Responsibilities:
1. Conduct European plant audits
2. Obtain necessary information, data, and agreements from European vendors, and send copy to MOO program office
3. Same as 1, 3, 4, 5, 6, 7, 8 for ZGO
4. Monitor vendors' monthly supplied data
5. Final STS decisions for Europe
Korean Procurement Center (KPC)
Far East/Asia
Key Contact:
K. B. Nam
DEKVC::KIBONGNAM
Or Designated Engineer
Responsibilities:
1. Conduct plant audits of Far East and Asian vendors' manufacturing sites
2. Obtain necessary information, data, and agreements from Far East/Asian vendors, and copy MOO program office
3. Monitor vendors' monthly supplied data (Far East/Asian vendors)
Japan Procurement Center (JPC)
Far East/Asia
Key Contact:
K. Inoue
TKOVOA::INOUE_KE
Or Designated Engineer
Responsibilities:
1. Conduct plant audits of Far East and Asian vendors' manufacturing sites
2. Obtain necessary information, data, and agreements from Far East/Asian vendors, and copy MOO program office
3. Monitor vendors' monthly supplied data (Far East/Asian vendors)

Figure 2: SHIP TO STOCK PROCESS FLOW FOR DRAMS


Initial Qualification complete, Production Shipments begin
Collect necessary information and documentation from vendor; Schedule and conduct audit of vendor manufacturing plant(s). Perform electrical/mechanical test process alignment (See Section 4)
Collect Incoming Inspection (electrical/mechanical) and module performance data for six months and on 500K pieces, minimum. Key electrical parameters will be monitored at Incoming Inspection and defect monitored at module level (See Section 5)
Does the data indicate consistency and stability in the vendors' process? (See Section 6)
NO
Part is not placed on STS, but will be monitored and placed in STS if/when performance dictates.
YES
Collect STS evaluation data (as before) on 100K pieces and for one month, minimum
Place part on STS
Requalify part
Requalify part
Monitor DRAM performance data; (See Section 6) Performance not conforming to STS criteria may be removed from STS pending corrective action
Vendor changes part requiring requalification
NO
Is it a major change? (See Section 8)
YES

3 COOPERATION NEEDED FROM THE VENDOR

Participation in the program is/will be specifically identified as a business requirement in the Basic Order Agreement under which Digital purchases DRAMs. Since implementation of the STS and Quest programs are important elements in the Corporation's strategy to become a world class manufacturer, Digital expects full support and compliance to the business requirements as outlined for implementation of the program. This section highlights the specific areas of required vendor support.

3.1 DATA AND INFORMATION REQUIRED FROM THE VENDOR

The vendor must agree to furnish Digital with the following information. Some information is required before being placed on STS, and other information after being placed on STS.

The following information shall be obtained from the vendor to give Digital insight into the vendor's controls and monitors to ensure that Digital receives DRAMs with high quality and reliability.

- Ongoing Reliability Monitor Process
  The minimum is to include voltage, temperature, sample size, length of test, cycle time, patterns run, criteria used in evaluating result, and the maximum failure rate allowed before a corrective action plan is triggered. Also, vendor must state how often such a reliability monitor test is done.
- Outline of Quality Assurance (QA) Program
  To list all QA tests done, frequency of tests, conditions, and pass/fail criteria.
- Outgoing production test flow, including burn-in, visual mechanical inspection, and outgoing QA tests.
- Outgoing electrical test conditions, including electrical test limits for all dc and ac parameters, including any guard bands used.

3.2 STS AGREEMENT

Vendors must agree to the basic STS agreement in this document. The parts will not be placed on STS without these agreements from the vendor. (See Appendix B.)

3.3 PLANT AUDITS

An audit will be done on the vendor's complete manufacturing facilities, using the audit process contained in this document. Additional checks of QA points will be done as part of the audit. In addition, these audits may be done periodically, depending upon the vendor's quality and reliability performance. This audit should be done towards the end of the six month performance evaluation stage. (See Heading 9 for more information on the audit.)

3.4 MONTHLY INFORMATION TO BE SUPPLIED BY VENDOR

The following monthly data will be obtained from the vendor on a quarterly basis:

- Reliability monitor test results, based on subhead 3.1.
- A summary of the vendor's QA test data for that month, based on subhead 3.1.

3.5 TIMING OF REQUEST FOR VENDOR INFORMATION

Gathering of vendor information must begin as soon as the part begins shipping to Digital on a production basis, after qualification completion. In this way, receipt of this information will not prevent placing the part on STS after all other criteria have been met.

3.6 ACTION TAKEN IF A VENDOR DOES NOT COMPLY WITH THE DIGITAL STS PROGRAM

Digital Purchasing will inform vendors that are unwilling to cooperate with Digital on the STS program that their refusal to supply required data will be a determining factor for qualification by Digital to procure DRAMs. The vendors' lack of cooperation causes Digital to perform an incoming inspection on the vendors' parts, and this is costly to Digital.

4 DRAM PERFORMANCE MONITORS AT DIGITAL

4.1 DATA COLLECTION BY DIGITAL BEFORE PART IS PLACED ON STS

Digital will collect data on the vendor parts as they are received and used while information is collected from the vendor.

Incoming Inspection (I.I.) will keep the following information to be reviewed at the STS decision point.

- Quantity of lots processed; quantity passed/failed
- Total quantity of parts processed
- Records of any mechanical problems found with the parts at Incoming Inspection
- Records of measurements of key electrical parameters made during Incoming Inspection sample testing. The data on each parameter will be plotted against time to help determine if the vendor's process is exhibiting consistency. These key parameters have been identified, and implementation of this monitoring is already in process. Thirty randomly selected samples per month will be run through this data collection process. The minimum, maximum, and mean for each parameter will be determined and plotted.

4.2 MODULE DEFECT RATE MONITOR

Component Engineering will track the defect rate of the parts on Digital memory modules in the manufacturing environment. Again, this data will be plotted versus time for another gauge of the vendors' process consistency. For the six months preceding the STS decision, the rolling average over a three month period must not be greater than 300 parts per million (ppm), and no month may be greater than 400 ppm.

To make this measurement meaningful, a reasonably high quantity of parts must be processed, such that a small number of failures does not result in an extremely high monthly ppm failure rate; that is, the responsible engineer must make a judgment on the significance of each monthly ppm measurement based on the quantity of parts processed.

4.3 RELIABILITY MONITORS

During this first six months, at least two reliability monitors will be done on the part.

4.4 USAGE COMPLIANCE TO STS REQUIREMENT

- 500K pieces shall be accumulated for a particular die; that is, n×1 and n×4 are typically metal mask options of each other and may typically be combined to accumulate 500K pieces.
- For specialized application parts, such as video RAMs and n×4 parts that are not metal mask options of the n×1 part, a reduced criteria may be used due to the smaller volume usage of these parts. The criteria for such specialized application parts is 125K pieces minimum and six months minimum.

5 EVALUATION OF VENDOR SUPPLIED DATA AND DIGITAL GENERATED DATA

5.1 STS CRITERIA

The vendor supplied data and the Digital generated data will be available six months after the parts have begun shipping to Digital, if the program is executed properly.

The following criteria must be met for a particular part to be placed on STS.

- Documentation of the vendor's QA program, Reliability Monitor processes, and Outgoing Production test flow provided to Digital must be acceptable. (See Heading 10.)
- Successful completion of audits of appropriate vendor manufacturing facilities. (See Appendix A.)
- The vendor agrees to supply Reliability Monitor and QA data requested on a quarterly basis.
- No lot rejections at Digital Incoming in the six months and minimum 500K pieces processed preceding the decision to place the part on STS (six months and 125K pieces for specialized application parts).
- Successful monitoring of electrical parameters at Incoming Inspection. The criteria to be used to evaluate this data is still being developed.
- Module quality levels must consistently be below 300 ppm, and each three consecutive month rolling average must be no greater than 300 ppm. No individual month may be greater than 400 ppm. (These numbers shall be calculated by total parts used and total *confirmed* defective parts seen in a particular month, during the six month/500K piece evaluation periods. Again, the responsible engineer may need to make an engineering judgment as described in subhead 4.2.)
- The outgoing electrical test conditions supplied by the vendor will be compared to the Digital specification for the part, to ensure that the vendor is testing at least to Digital's specifications. If exceptions are found, the vendor shall tighten their outgoing electrical test in order to satisfy all Digital electrical parametric specifications.

6 MONITORING OF PERFORMANCE OF PARTS ON STS

6.1 CRITERIA FOR STAYING ON STS

After placement on STS, if any of the regular monitoring activities, whether it be audits, vendor supplied data, or Digital generated data, indicate that the parts are not meeting all of the above STS criteria, the part may be removed from STS status. For example, if the three month rolling average module quality level goes above 300 ppm, or an individual month goes above 400 ppm, the part will be removed from STS status.

6.2 IF THE PART BEGINS TO PERFORM OUTSIDE STS REQUIREMENTS

If the part begins to perform outside STS requirements, the part will return to regular Incoming Inspection, while failure analysis is done and a corrective action is generated by the vendor and Digital. After a corrective action plan is identified and agreed upon by the vendor and Digital, it will be implemented. To prove that the corrective action is effective, STS data will be collected by Digital on 100K pieces or one month's supply of parts, whichever is greater (for specialized application parts, 25K pieces or one month's supply of parts, whichever is greater). This data must indicate a significant improvement from pre-corrective action performance, and be consistent with the improvement expected from the corrective action taken. It must meet all the STS criteria outlined previously. If these conditions are met, the part will be reinstated to STS status.

6.3 QUALITY AND RELIABILITY REVIEWS

Quality and Reliability performance will be reviewed with the vendor on a biannual basis.

6.4 PARAMETRIC MONITORING PROCESS

On a monthly basis, 30 samples of each STS part will be electrically tested for measurement of the critical parameters, which were initially criteria for STS. This is one additional method to monitor vendor performance.

7 HOW TO HANDLE CHANGES MADE TO STS PARTS BY VENDORS

When an STS part is changed by the vendor, as shown in (but not limited to) the Change Control portion of the Digital vendor STS agreement, the responsible engineer will perform a re-qualification.

Based upon the extent of the change, result of the re-qualification, history of the vendor, and any other pertinent data, the responsible engineer will make a recommendation to the STS committee to either keep the part on STS or to revoke STS status of the part and to perform a data collection process on the changed parts.

If the STS status is revoked, STS data will be collected on a minimum of 100K pieces or one month's supply of parts, whichever is greater. For specialized application parts, STS data will be collected on 25K pieces or one month's supply of parts, whichever is greater. If, in the responsible engineer's judgment, more than 100K or 25K pieces, or longer than one month's data is required before an acceptable confidence level is reached, then the engineer may require requalification. The quantities and time period stated are minimum requirements.

If the data shows that the change to the part has not negatively effected the overall quality of the part, it will be reinstated to STS status.

8 VENDOR QA PROCESS EVALUATION

8.1 PURPOSE OF EVALUATION OF VENDOR QA PROCESS

The purpose of evaluating the QA program/process supplied by the vendor is to determine if a document is in place to continually measure product quality and reliability. it also is an introduction to the vendor's QA process.

Therefore, the purpose of this section is not to measure the QA process against any specific pass/fail criteria, but simply to ascertain that such programs exist within the vendor's manufacturing process. Measurement of the goodness of these programs occurs during the audit portion.

9 AUDIT PROCESS

9.1 REFERENCE DOCUMENTS USED FOR STS AUDITS

There are two documents at Digital that were written for vendor certification and ship to stock type activities. These two documents shall serve as guides and references for the plant audit process for placing DRAMs on STS.

The documents are:

A-SP-ELMF406-xx	Quest Program for Integrated Circuits
A-SP-ELMF520-xx	Digital Supplier Certification Program

Due to the general purpose nature of these two documents, they will not address specific issues pertaining to DRAMs. However, an addendum to these documents, with DRAM specific criteria, is being developed, and will be included in the next revision of this document.

9.2 ELMF406 QUEST PROGRAM FOR INTEGRATED CIRCUITS

ELMF406-07 *Quality Enhanced Supplier Test Program for Integrated Circuits (QuEST) Program-Process Alignment/Source Audit*, concentrates on the specific QA/QC type tests done by the vendor, and is intended to determine whether these QA monitors and tests done by the vendor meet the criteria set in Digital by its General Quality Specification. All applicable sections of ELMF406-07 must be done (for example, some sections pertain to only ceramic packaged parts).

ELMF406 is intended primarily for use in Assembly Plant audits.

9.3 ELMF520 DIGITAL SUPPLIER CERTIFICATION PROGRAM

ELMF520-2 *Manufacturing Systems Assessment Procedure - Checklist for Supplier Certification* addresses many issues pertaining to the vendor's overall manufacturing process. ELMF520 may be used as an introductory step during the Fabrication Plant audits. These questionnaires should be submitted to the vendor at least one month before the audit. The vendor should answer all the questions and then review the responses in the early part of the fabrication audit.

The following exhibits within this document should be completed for the purpose of DRAM vendor audits.

Exhibit 1	Assessor Review Form
Exhibit 2	Assessment Action Report
Exhibit 3	General Supplier Data
Exhibit 6	Plant Systems and Mfg. Process Assessments
Exhibit 7	Materials Overview
Exhibit 8	Supplier Management
Exhibit 11	Incoming Inspection
Exhibit 13	Manufacturing Documentation
Exhibit 15	Process Control
Exhibit 16	In-Process Non-Conforming Material Control

Exhibit 17 Diagnostic Software Control
Exhibit 18 Calibration
Exhibit 19 Preventative Maintenance
Exhibit 22 Facilities Management
Exhibit 23 Document Control
Exhibit 25 ECO Control
Exhibit 26 Reliability Measurements
Exhibit 27 Product Audit
Exhibit 29 Corrective Action System
Exhibit 30 Quality Information Systems
Exhibit 32 Packaging/Packing/Shipping/Warehousing
Exhibit 33 Customer Satisfaction
Exhibit 34 Failure Analysis
Exhibit 35 Traceability

9.4 ADDITIONAL AUDIT REQUIREMENTS

Additional data/information may be required, and other areas may require auditing during the audit process, particularly in the fabrication audit portions. If this is necessary, these requirements will be conveyed to the vendor in advance of the audit.

10 STOCKROOM PROCEDURE FOR DRAMS ON STS

The responsibility of materials and purchasing representatives is to ensure that STS materials can be received without any problems, such as the first arrival of new revisions of a part that are qualified. The part number does not change, however, this new revision will not be considered STS until it has been initiated into the production process for a predetermined amount of time.

Therefore, there must be a process in place to ensure that this new material is not mistakenly placed in the STS status.

The process for working STS is:

- STS for a device is determined by accumulating information regarding all aspects of usage; that is, device test, module test, system test, and so forth.

  NOTE

  A device can only be added to STS by a message issued by the DRAM Program Office in MOO.

- All Purchase Orders (POs) should include device revision in order to distinguish between STS parts and new parts which have not been determined to be included in STS yet. POs should be revision controlled.
- One way of tracking incoming material and determining whether or not it is STS material is to have two different numerical stockrooms for receipt of material.

  NOTE

  This does not recommend the creation of new stockrooms, but the usage of current stockrooms which plants already have in place.

  EXAMPLE:
  MOO has S/R 46 for material which must be tested and S/R 340 for inventory which is currently deemed STS, or has been tested. MOO will have STS shipped to 340 and non-STS material will go to 46.

In placing POs with the above process, it will ensure that *new* revisions are not included with the STS material until they are officially released to STS.

APPENDIX A STS STATISTICAL ANALYSIS

The information in this appendix shows a statistical analysis of some of the numbers used in the STS process.

- A 500K piece minumum (main memory) usage of a part at Incoming Inspection (I.I.), no rejected lots allowed in first (or most recent) 500K piece usage, required for part to be placed on STS:

  Historical data shows that the average lot size for a main memory part is 30K pieces. Therefore, 17 average-sized lots must be processed at I.I. with no rejected lots. Using the Poisson distribution, a statement may be made that "there is a 60% confidence level that less than 6% of future lots would fail I.I."

  The calculated number of failures for 0 failures and 60% confidence level is 0.92, using Poisson. Dividing this by the number of lots tested (17) gives approximately 5.4%.

- Using the same analysis for specialized application, or non main memory parts:

  Average lot size has been 7K pieces. To collect the same number of data points (lots) as for main-memory parts, would require usage of $7000 \times 17 = 119{,}000$ parts. A round figure of 125,000 pieces has been chosen as the requirement.

  NOTE

  Non main memory parts have a much smaller volume usage than main memory parts.

- The six month requirement prevents a part from being placed on STS if 500K pieces are received in the first couple of months the part is qualified. It requires evaluation over a period of time, so that the part and its manufacturing process may be evaluated for consistency of quality at the module level, and by the device parametric monitoring program that is an integral part of the STS program.

  If a risk calculation is made (see next bullet), it can be shown that the risk of having a defective part is inversely proportional to the number of (good performance) data points observed; that is, more data points results in a smaller sigma, resulting in a narrower normal distribution curve, with a tail that drops sooner, which in turn results in a smaller area of the distribution curve being outside of the specification.

  By the time six months of module level data is collected, there will be seven or eight months of I.I. data available, due to the time lag in the manufacturing cycle.

- Module performance evaluation: The module defect rate specification is 500 parts per million (ppm) maximum (pending approvals) and the module defect criteria for STS considers this.

  The ppm defect rates for the six month evaluation period must have any three consecutive months rolling average no greater than 300 ppm, and no single month greater than 400 ppm. The following examples show how typical module defect rate distributions would fit into this requirement.

Example 1:

Vendor A 1M×1 module defect rate performance for a six month period was: 114, 289, 249, 246, 292, 150 ppm. (A good quality vendor).

mean = 223 ppm and sigma = 74

$$z = \frac{500 - 223}{74} = 3.74$$

From z table, probability = less than 0.1% of exceeding 500 ppm.

Similarly, probability of going over 400 ppm, the point at which STS status must be revoked, is less than 1%.

Example 2:

Vendor X 1M×1 module defect rate for the first four months of its use at Digital was 622*, 165, 336, 363 ppm. (A poor quality vendor).

* This figure reflects the first three months combined data.

mean = 371 ppm and sigma = 189

$$z = \frac{500 - 371}{189} = 0.68$$

There is a 24.8% chance of exceeding 500 ppm and, similarly, there is a 44% chance of exceeding 400 ppm.

APPENDIX B DIGITAL/VENDOR STS AGREEMENT

B.1 SAMPLE PROCESS AGREEMENT FORM

This appendix contains a sample Quality Enhanced Supplier Test/Ship to Stock, QuEST /STS program process agreement.

digital™

DIGITAL EQUIPMENT CORPORATION

INTEGRATED CIRCUITS

QUALITY ENHANCED SUPPLIER TEST/ SHIP TO STOCK

QuEST/STS

PROGRAM

PROCESS AGREEMENT

digital™

QuEST/STS PROCESS AGREEMENT

BETWEEN

INSERT VENDOR NAME

AND

DIGITAL EQUIPMENT CORPORATION

digital™

SIGNATURE PAGE

VENDOR NAME	DIGITAL EQUIPMENT
NAME Quality Engineering Manager	NAME Quality Engineering Manager
	Component Engineering Manager

Date:

Revision:

Process Agreement

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1. PURPOSE

This document defines the applicable manufacturing and quality process, procedures, and control systems which assure products conform to the requirements of Digital's QuEST/Ship to Stock (STS) program. The program covers Large Scale Integrated semiconductor devices including DRAMS. This document provides for ongoing quality assurance and reliability data to be routinely transmitted to Digital, as well as providing for periodic surveillance audits by Digital of facilities, operations, and systems which produce QuEST/STS product. Implementation of this agreement may allow Digital to suspend incoming inspection.

2. SCOPE

This document shall apply to only those products which are specifically listed as QuEST/STS products and have been certified as such. This document will cover the documentation and control of the methods and procedures for manufacturing, quality, and reliability systems for those integrated circuits on Digital's QuEST/STS program.

3. PROCUREMENT

This document is not to be construed as a purchase agreement, purchase order, or in any manner a commitment of obligation on the part of Digital to purchase or of Vendor to sell any products. The obligation of Digital with respect to the actual purchase (and sale of products shall be as established in any purchase) agreements or purchase orders separately entered into between the parties.

This document in no way limits, supersedes or abrogates any contractual obligation, warranty or other requirement specified in any purchase agreement or purchase order. Vendor shall remain totally responsible for the effective control of product quality and reliability and shall ship only product which conforms to the requirements of any purchase agreement or purchase order applicable to the product.

Implementation of this agreement shall not waive Digital's right to perform normal inspection per lot acceptance procedures and to rightfully reject any product found by Digital to be nonconforming pursuant to the requirements of any purchase agreement or purchase order.

4. APPLICABLE DOCUMENTS, STANDARDS, AND SPECIFICATIONS:

This section lists the document number and document title for all the applicable procedures and processes for manufacturing, quality assurance, and quality control relating to wafer fabrication, assembly, environmental test, electrical test, and final Q.A. documents shall be included for all applicable facilities.

Applicable Digital Documents:

SPEC. DIGITAL	DESCRIPTION	REV	DATE
A-PS-2100006-GS	DRAM general quality spec.		
A-PS-2100008-GS	Dimensions and package requirements for chip carriers		
A-SP-ELMF406	QuEST Program for Integrated Circuits		
A-SP-ELMF520	Digital Supplier Certification Program		
A-SP-ELMF731	Ship To Stock Process for DRAMs		

APPLICABLE VENDOR DOCUMENTS:

To Be Supplied

5. PROCESS DEFINITIONS, DESCRIPTIONS, AND FLOWS.

This section shall describe the applicable processes, flows, geographic facilities, methods and conditions used in the manufacture and testing of integrated circuits on the QuEST/STS program, as well as the quality systems for assurance control and monitor of those processes. This section shall cover these areas for the following :

a. Definition of incoming materials
b. Q.A./Q.C. wafer fabrication flow chart(s) by technology
c. Assembly product flow chart(s) by package type
d. Final Electrical Test
e. Product Marking

1. Products that have been certified for the QuEST/STS program and have any special tests, processes, or screening will be identified by the letter "Q" marked on the top surface of the package.
2. The "Q" marking shall be consistent for each device type and separated from other marking by at least on character space.
3. Specific marking for each device will be provided to Digital Equipment Corporation.

f. Final Q.A. inspection

The final Q.A. inspection is as defined by Vendor in their Q.A. manual, as listed in Section 4.

g. Second source/subcontractors are subject to the same process certification and ongoing process control, reliability, and product attributes data requirements as the supplier for any devices which will be shipped as QuEST/STS product.

6. CHANGE CONTROL

All processes and documentation shall be controlled under the existing system as defined in (Vendor's Document Control Specification) which requires appropriate approval to be obtained before any changes are made to processes, procedures, documentation, or methods by which product is manufactured, inspected, processed, or evaluated. Approval shall include an appropriate level of engineering and quality personnel.

A. MAJOR CHANGES

1. Vendor shall notify Digital STS Program Office of any major changes in product or manufacturing process.
2. Vendor shall be responsible as part of this agreement to provide the procedural assurance system to control changes. Notification of major changes shall be accompanied by supporting data.
3. Major changes shall be accepted in writing by Digital equipment prior to shipping product with the change incorporated.
4. If any proposed changes affect the quality of devices covered in this agreement, Vendor shall notify Digital in the form of an advisory change notice letter specifying the description of the proposed change, implementation requirements and timeframe.
5. All change control requirements specified in Digital A-PS-2100006-GS shall form part of this agreement, as a supplement to this document the following list of major changes shall also be included.
   - Q.A. test program change of the limits of any parameters so that they fall outside those limits to which they were aligned under the QuEST/STS correlation and alignment activities.
   - Q.A. change to the methodology, techniques, or equipment upon which the devices are tested using the QA test program.
   - Changes to Q.A. acceptance plans Q.A. controls and release procedures.
   - External dimension changes
   - Lead plating or finish changes
   - Major mask changed, for example, layout changes to elements, die shrinks.
   - Significant material changes, for example, encapsulation, leadframe, or die attach materials.
   - Composition or process method for

     * Dielectric oxide

* Metalization
* Passivation qqq

- Wire bonding technique or material
- Die attach technique or material
- Sealing method or materials
- Manufacturing facility locations not previously certified
- Final product assurance test programs and lot acceptance plans
- Change in the use of subcontractors.

B. MINOR CHANGES

1. Do not require prior notification to Digital.
2. Notification of changes shall be provided during periodic quality meetings.
3. Do not affect performance, quality, reliability, or interchangeability.
4. Examples:
   - Minor mask changes
   - Line cleanup, emulsion to chrome, contact alignment
   - Noncritical process changes

7. ONGOING DATA AND REPORTING REQUIREMENTS

Information, in the form of defective parts per million, for electrical and visual/mechanical testing combined shall be supported by the Quality attributes data. Ongoing process monitor data, (as defined in Section 10(ii)) will be provided on a quarterly basis to confirm the outgoing quality levels of QuEST/STS product as follows:

a. Data from final Q.A. in mutually agreed format, for
   - Final electrical quality
   - Visual/mechanical and environmental
   - Outgoing quality report

b. Agreed statistical and/or variables data defining process control

8. RELIABILITY AND PRODUCT MONITOR PLANS

RELIABILITY MONITORS AND SYSTEMS

This section defines the current monitors, processes, and systems including the methods, conditions, and frequencies for assuring that the quality and reliability of products will the following goals.
<500 FITS @ Ta = 70°C
Ea = 0.44eV

Monitor tests, at a minimum, will be performed to assure device reliability to the levels listed above. Data will be supplied quarterly for ongoing reliability monitors. Some examples of monitors are as follows:

- High temperature operating life
- Lead plating thickness and composition
- Temperature humidity bias
- Autoclave or pressure cooker
- Electrostatic discharge (ESD) sensitivity
- Highly Accelerated Stess Test (HAST)
- Temperature cycle
- Other applicable packaging, product, or reliability

9. AUDITS OF SUPPLIER'S FACILITIES

To assure the continued compliance to the requirements of the QuEST/STS program, Digital may audit Vendor's facilities. Such audits will be carried out as follows.

a. The QuEST/STS auditor will notify Vendor's quality assurance manager in advance of the visit.

b. Preaudit overview presentation at the facility being audited.

c. Perform the audit of critical process areas.

d. Post audit presentation of audit findings before leaving the facility.

e. Digital shall prepare and submit to Vendor a complete audit report detailing the results and findings of the audit.

10. APPENDICES

i DEVICES AND FACILITIES QUALIFIED FOR QUEST/STS PROGRAM.

The following material shall be subjected to purchase by Digital in accordance with requirements of QuEST/STS program:

Digital Part Number	Vendor Part Number	Description
21-xxxxx-xx		Example: 1 Mbit Dynamic RAM [1048576x1] in plastic SOJ housing.

Approved Manufacturing Locations:

ii CRITICAL DATA TO BE SUPPLIED BY VENDOR

a. Product assurance data is required for all product lots shipped in the following format.
   - Digital part number
   - Vendor part number
   - Date code and package, type ID
   - P.O. number
   - Vendor lot number and lot quantity
   - Certification that the lot was 100% electrically tested.

b. Electrical variables data (AC and DC) to be provided every quarter.

Minimum Electrical Parameters to be Characterized

21-xxxxx-xx

1.	IDD1	Standby current (RAS, CAS high)
2.	IDD4	Operating current
3.	IDD5	RAS only current
4.	IDD6	CAS before RAS current
5.	IDD7	Page mode current
6.	VIL	Input low level
7.	VIH	Input high level
8.	VOL	Output low level
9.	VOH	Output high level
10.	TRAC	RAS Access time
11.	TCAC	CAS Access time
12.	TASR	Row address setup time
13.	TASC	Column address setup time

iii VENDOR DOCUMENTATION

APPENDIX C REFERENCED DOCUMENTS

C.1 EL-Class Digital Documents

EL-Class Number	Document Title
EL-MF406-07	*Quality Enhanced Supplier Test Program for Integrated Circuits (QuEST) Program-Process Alignment/Source Audit*
EL-MF520-02	*Manufacturing Systems Assessment Procedure - Checklist for Supplier Certification*

Use VTX SMC to order copies of EL-class documents from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

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